

STRUCTURAL CHANGE, TOTAL FACTOR PRODUCTIVITY AND SECTORAL LABOR PRODUCTIVITY IN SELECTED AFRICAN COUNTRIES*

AFRİKA ÜLKELERİNDE YAPISAL DEĞİŞİM, TOPLAM FAKTÖR VERİMLİLİĞİ VE SEKTÖREL İŞGÜCÜ VERİMLİLİĞİ

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Abstract

The transition from low income to high-income countries requires a change in the production structure of an economy. This paper examines structural change and its implication on TFP growth and sectoral labor productivity for a sample of African countries (Burkina Faso, Ethiopia, Madagascar, Mozambique, Tanzania, and Uganda) for 1991-2017. Using the panel data fixed effects model with Driscoll-Kraay standard error estimation technique, we find that structural change has contributed significantly to the growth of TFP. But it didn't have any effect on sectoral labor productivity. Therefore, countries should promote relocation of labor from agriculture sector to the modern sectors to increase TFP growth rate.

Keywords: Structural change, labor relocation, Shift-share analysis, Total factor productivity, Sectoral labor productivity

JEL Classification: O14, N27, O10, O47

Öz

Düşük gelirden yüksek gelirli ülkelere geçiş, bir ekonominin üretim yapısında bir değişiklik gerektirir. Bu makale, 1991-2017 yılları için Afrika ülkelerinden bir örnek (Burkina Faso, Etiyopya, Madagaskar, Mozambik, Tanzania ve Uganda) için yapısal değişimi ve toplam faktör verimliliği artışı ve sektörel işgücü verimliliği üzerindeki etkisini incelemektedir. Driscoll-Kraay standart hata tahmin tekniği ile panel veri sabit etkiler modelini kullanarak, yapısal değişikliğin TFV'nin büyümesine önemli ölçüde katkıda bulunduğunu görüyoruz. Ancak sektörel emek üretkenleri üzerinde herhangi bir etkisi olmamıştır. Bu nedenle ülkeler, toplam faktör verimliliği büyüme oranını artırmak için emeğin tarım sektöründen modern sektörlerle taşınmasını desteklemelidir.

Anahtar Kelimeler: Yapısal değişim, emeğin yer değişimi, Shift-share analize, Toplam faktör verimliliği, sektörel emek verimliliği

JEL Sınıflandırması: O14, N27, O10, O47

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I. Introduction

Structural change is a transformation of an economy from low productive and labor intensive to high productive and skill intensive economic activity (Oyelaran-Oyeyinka et al., 2016; Markus and Francis, 2013). It is conceptualized as a change in the aggregate component of the economy (Thakur, 2011). When one or more sectors of the economy grow faster than others, structural change is likely to happen. The difference in productivity among sectors will be followed by a relocation of resources towards more productive sectors.

Structural change has a far-reaching influence on economic performance. According to Kruger (2008), its effect can be witnessed at different levels of aggregations. It results in a change in the characteristics of the three main sectors of the economy as well as the industrial composition within the sector and among firms in the industry. As labor moves from agriculture to modern¹ sectors, productivity rises and incomes expand (Vries et al., 2012). However, it is not always followed by an increase in total factor productivity. Not only the nature and speed with which structural transformation takes place but also the direction of movement of factors of production determine the effect of structural change on total factor productivity (TFP) and sectoral-labor productivities.

Developing countries have shown a structural change trend that deviates from the structural change developed countries have experienced. This trend causes a departure from the established relationship between structural change and other macroeconomic performance indicators. Most of these countries have shown positive structural change without having a rise in labor productivity which is unlikely to happen in developed countries (McMillan and Rodrik, 2011). Besides, the experience of African countries is full of heterogeneity. For example, Nigeria and Zambia have achieved a structural change that reduces overall productivity while Ghana and Ethiopia have exhibited a structural change that can be characterized as growth-enhancing. On the other hand, Mauritius followed a structural change pattern that is similar to developed countries (Neuss, 2018). Despite the above disparities on the nature of structural change in developing countries, they have demonstrated similar pattern on sectoral share of employment. The share of employment in agriculture has been declining due to relocation of labor towards modern sectors. However, the relocation of labor towards the manufacturing sector may not result in a rise in labor productivity due to its low level of labor productivity.

Furthermore, the effect of structural change on total factor productivity (TFP) growth in developing countries is not well studied. The limited number of empirical studies linking structural change to TFP growth is inconclusive (Isaksson, 2007). Likewise, the response of sector-specific labor productivities to structural change in these countries is not defined yet. Hence, it appears that it is difficult to make any formal conclusion about the relationship between structural change and productivity in Africa. Thus, in this study, we investigated (1) whether a shift in structural change leads to a change in TFP growth of the overall economy (2) the effect

¹ Modern sectors, in this paper, refers to manufacturing and service sectors.

of the shift in structural change at disaggregated sectoral level labor productivity². Estimating the effect of structural change on the TFP and sector-specific labor productivities for a sample of African countries has paramount importance in understanding the effect of labor relocation on economic performance of these countries.

Using a fixed-effects model with Driscoll-Kraay standard error estimation technique, we find that a significant and positive effect of structural change on the growth rate of TFP. This implies that relocation of labor towards more productive sector increases total factor productivity through creating better combination of factors that increases growth rate of TFP. Similar study by Bah and Brada (2009) examined the effect of inter-sectoral movements of labor on aggregate TFP growth and capital accumulation for the new EU member countries and they came up with the result that structural change does have little or no effect on TFP growth.

On the contrary, we also find that structural change doesn't have any effect on sector-specific labor productivities. This result corresponds with Moussir and Chatri (2019) and with Mallick (2015) somehow. Mallick (2015) estimated the effect of structural change on labor productivity for BRIC countries and found a significant relationship only in China and India. But for Brazil and `Russia, structural change was not significant in affecting sectoral labor productivity. Similarly, Moussir and Chatri (2019) found that the intra-sectoral (within) component would account for much of labor productivity growth rather than the structural change.

The rest of the paper is structured as follows. In section 2, we present a simple conceptual framework. Section 3 discusses the overall characteristics of the sample countries. Data and stylized facts are presented in section 4. Section 5 presents the method of estimation and empirical findings. Finally, section 6 concludes.

2. Conceptual Framework

TFP is defined as a measure of output that is not explained by the amount of inputs used in the production process. It shows how efficiently the inputs are utilized in the production process. Traditionally, it is measured by Solow residual which can be estimated by using the growth accounting process through econometric estimation of production functions³.

Solow residual estimates TFP correctly if we assume a neoclassical production function and perfect competitive market. It is one of the basic indicators that constitute cross-country differences in growth and GDP. Therefore, based on the neoclassical growth model, the following theoretical framework is developed.

2 The disaggregated sectoral level TFP lacks the capital data, thus our sector analysis is restricted to labor productivity.

3 Assuming a Cobb-Douglas production function, the Solow residual is calculated as: $Solow\ residual = g_y - \alpha g_k - (1-\alpha)g_l$. Where, g_y is the growth rate of aggregate output, g_k is the growth rate of aggregate capital and α is the growth rate of aggregate labor and g_l is the share of capital.

Let the overall production function of a country i at time t , Y_{it} , is determined by the available resources like labor force (L_{it}), capital stock (K_{it}) and other exogenous factors (Z_{it}). It is also affected by other factors that cannot be labeled under labor, capital or other exogenous factors. These factors are usually given by the parameter A_{it} which usually represents TFP in the neoclassical growth models. Therefore, the overall production function of an economy can be given as;

$$Y_{it} = F(A_{it}, L_{it}, K_{it}, Z_{it}) \quad (1)$$

It can also be rewritten as;

$$Y_{it} = A_{it} (Z_{it}) F(L_{it}, K_{it}, Z_{it}) \quad (2)$$

Where A_{it} is still affected by external factors (Mastromarco and Zago, 2012) like structural change, technological advancement, and technical efficiency. The change in structural change, technical advancement and technical efficiency at country levels can only be captured by a change in TFP. This implies that TFP is affected by the change in one or more of these factors which cannot be explained by the external factors.

Therefore, this study estimates the effect of structural change on TFP by using the above simple framework. Eshetie and Kumuyu (2016) supported this framework by claiming that a shift in the relative contribution of sectors to GDP is supposed to bring higher total factor productivity, higher earning and profit. But it is not direct forward, rather the effect of structural change on the TFP is dependent on which sector is dominating the economy. Traditionally, manufacturing sector dominant economies are known to have higher total factor productivity than other countries with agriculture and service-dominant economies. Therefore, it is likely to respond fast to structural change.

3. Overall Characteristics of Sample Countries

For this analysis, six African countries are chosen based on the availability of data. These are Burkina Faso, Ethiopia, Madagascar, Mozambique, Tanzania, and Uganda. In this section, the basic economic and demographic characteristics are discussed.

3.1. GDP, GDP per capita and Rate of Unemployment

These countries are categorized as low-income countries. None of them have a real per capita GDP of greater than 1000 dollars by 2017 based on 2010 US dollar valuation. Tanzania has the highest per capita GDP of 937.3 while Madagascar scored the lowest with 481.4 dollars. But on average, their GDP per capita has been continuously increasing. The average GDP per capita growth rate for these countries over 1991-2017 was 2.54% which is small for low-income countries. They have achieved a positive average growth rate of per capita GDP for all years except 1991, 1992 and 1994. During these years, all of these countries except Uganda have been achieving a negative GDP per capita growth rate. However, in a nutshell, these countries have a positive growth rate

of GDP per capita between 1991 and 2017. But the state of unemployment is relatively small and surprising. By the year 2017, the average unemployment rate⁴ was 2.72% based on the data from WDI. It is way below the average unemployment rate of Sub-Saharan African countries which happens to be 6.121%.

3.2. Population Structure

Based on the data from WDI, these countries have one of the highest population growth rates in the world. The average population growth rate over 1991 – 2017 is 2.96% with no sign of intertemporal change. When it comes to the gender composition of the population, 50.5% of the total population is female by 2017.

The other important aspect in these countries is a rapid rural-urban migration with a rise in the percentage of people living in urban areas. In 1991, the average percentage of the population living in urban areas was 17.45% with the highest percentage of 25.5% in Mozambique and the lowest percentage of 12.9% in Ethiopia. However, by the year 2017, the average percentage of people living in urban areas has raised to 29.54%. Ethiopia had the lowest percentage of the population living in urban areas with 20.31% while Madagascar had the highest with 36.522%. In general, these countries have one of the highest growth rates of urban population in the world with an average annual growth rate of 5% from 1991 to 2017. By the year 2017, Uganda is the country with the highest growth rate of urban population among sample countries with 6.25% while Mozambique has the lowest with 4.4%.

4. Data⁵ and Stylized Facts

In this section, the characteristics of countries involved in this study will be explained in terms of the main variables to give a context before presenting the result.

4.1. Total Factor Productivity Growth

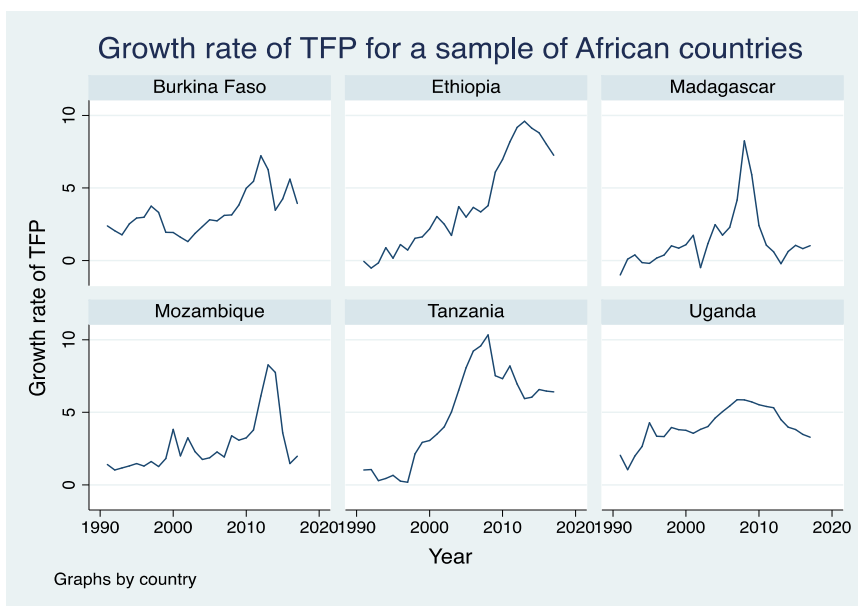
The average total factor productivity growth (TFP) of these countries is approximately 3.368%, with large variation across countries. As Figure 1 shows that the average growth rate of TFP has been showing fluctuations over the years. TFP growth of these countries was relatively small and sometimes negative for countries like Ethiopia and Madagascar during the first half of the 1990s. But it was positive for the rest of the countries for all years. Especially after the mid-2000s, these countries showed an almost similar trend of increasing, reached a maximum and then declining TFP growth. This makes sense when we compare this performance with their respective economic growth. Developing countries especially

4 It is measured as total unemployment as a percentage of total labor force (Modeled ILO estimate) and the data is adopted from WDI (2019).

5 The nature and source of data is summarized in Table 5.

sub-Saharan African countries have been achieving rapid economic growth of 5% between 2000 and 2012 until they face a sluggish economic growth after 2014. Therefore, it is not a surprise for these countries to have a positive TFP growth for most of the years since the beginning of this century. This argument is supported by Bah (2014) that countries with a relatively higher rate of economic growth are known to have a higher level of TFP growth. Specifically, he asserted that countries or sectors with the worst growth performance suffered mostly from low or negative TFP growth.

Figure 1: TFP Growth of a Sample of African Countries Over 1991-2017



Source: The Conference Board Total Economy Database™, (Adjusted version), April 2019

4.2. Sectoral Labor Productivity

The existence of a sizable gap in labor productivity between sectors is a fundamental reality of developing countries (McMillan and Rodrik, 2011; Lewis, 1954). This reality holds for our sample too. Labor productivity in the service sector is higher than in both the agricultural and manufacturing sectors. On average, as it is summarized in Table 1, the labor in the service sector is 5 times more productive than labor in the agricultural sector. Similarly, labor productivity in the manufacturing sector is 3.4 times of the agricultural sector. These numbers are much higher than what McMillan and Rodrik (2011) have estimated for Africa. They have calculated that the average manufacturing to agriculture sector labor productivity ratio is 2.3 in Africa,

2.8 in Latin America and 3.9 in Asia which reveals that our sample countries experience a much higher labor productivity gap than an average African country. On hierarchical basis, labor productivity in the service sector is higher than that of both in the manufacturing and service sectors. This explains why there is a rapid rise in both the share of employment and GDP contribution of the service sector since 1991. Therefore, the positive structural change that we have illustrated in Tables 2, 3 and 4 is the result of the gain in labor productivity due to the fact that the relocation of labor from agriculture to manufacturing and service sectors, and from manufacturing to service sectors outweighs the loss in labor productivity from the labor mobility of reverse direction.

Table 1: Summary of Sectoral Average Labor Productivities of Selected African Countries over 1991-2017

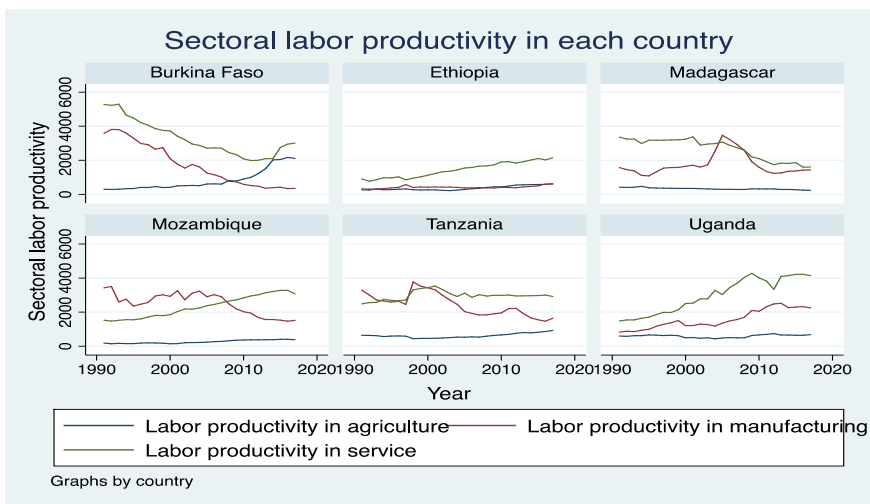
Sectoral labor productivities	Mean	Standard deviations	Minimum	Maximum
Labor productivity in agriculture	499.897	327.159	142.257	2164.14
Labor productivity in manufacturing	1733.619	989.2235	247.039	3809.19
Labor productivity in service	2610.814	938.49	767.863	5294.54

Source: Author's calculation based on the data from WDI

Equally, Figure 2 shows the historical trends of labor productivities in the sample of African countries. Labor productivity trends of different sectors have been changing across periods for each country. Labor productivity in the service sector has been increasing continuously since 1991 for Ethiopia, Mozambique, and Uganda. But it is unusually declining for Burkina Faso and Madagascar. This is too early for countries with a larger proportion of their population is still employed in the traditional sector.

On the other hand, labor productivity in the agriculture sector is found to be small and stagnant. Only Burkina Faso managed to increase agricultural labor productivity since 2011. This might be due to the relocation of labor from agriculture to non-agricultural sectors without a significant change in production volume. Similarly, labor productivity in the manufacturing sector has been declining for all countries except Uganda. Uganda's labor productivity growth in both the manufacturing and service sectors are impressive. But for all countries, the productivity of labor in the service sector is higher than in any other sector by 2017.

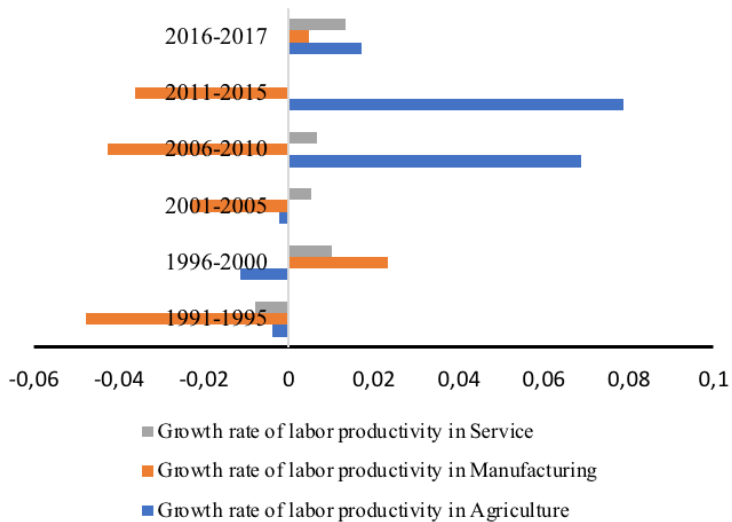
Figure 2: Sectoral Labor Productivity of Selected African Countries



Source: Author’s calculation based on the data from WDI

Alternatively, a five-year average growth rate of labor productivity in each sector is provided by Figure 3.

Figure 3: A Five-year Average Growth Rate of Sectoral Labor Productivities for a Sample of African Countries



Source: Author’s calculation based on the data from WDI

Based on Figure 3, the five-year average labor productivity growth rate for all sectors was negative over 1991-1995. During these years, in Africa, the population has grown much faster than the economy which results in a decrease in labor productivity for all sectors. On top of that, sample countries except Uganda achieved a negative GDP growth rate that exacerbated the situation. But for the next five years (1996-2000), the growth rate of labor productivity in the service and manufacturing sectors becomes positive. Basically, since the mid-1990s, labor productivity in the service sector has been consistently positive.

Similarly, the five-year average labor productivity growth in the manufacturing sector revealed that it has been negative for all years except between 1996 and 2000 and after 2016. But on average, the growth rate of labor productivity in the manufacturing sector has been negative since 1991. This claim is supported by McMillan and Rodrik (2011). They asserted that labor productivity in the manufacturing sector in developing countries is found to be stagnant and sometimes declining.

The growth rate of labor productivity in the agriculture sector has shown a dramatic change after 2005. A five-year average labor productivity estimation shows that the growth rate of labor productivity in agriculture has been positive since 2005. Both the rapid mobility of labor towards non-agricultural sectors and technical advancement within the sector contributed for the positive growth rate of labor productivity in agricultural sector.

The labor productivity gap between agricultural and modern sectors has also shown a specific trend. Starting from the early 1990s, the labor productivity gap has been increasing until the early 2000s. However, after the 2000s, the gap has begun to narrow because of a decline in labor productivity in manufacturing and an increase in labor productivity in the agriculture sector. This can be cross-checked by estimating the ratio of labor productivity in non-agricultural sectors to the agricultural sector. Hence, the ratio first increased and reached a maximum and began to fall. This implies that the labor productivity gap between sectors has changed with time. McMillan and Rodrik (2011) also came up with similar trend that the labor productivity gap between agriculture and the non-agricultural sector first increases and then declines which means the ratio of agricultural to non-agricultural labor productivity exhibits a U-shaped pattern with time.

There is an important economic logic behind the U-shaped curve of the agriculture-modern sector labor productivity ratio. Since most developing countries have few modern sectors, the productivity gap will increase as the economy began to grow (McMillan and Rodrik, 2011). Usually, the source of growth in these countries is public and private investments in the non-agricultural sector and urban areas. However, as the economy grows, labor begins to move to the modern sector so that labor productivity began to converge. This scenario also proves the dual economy theory of Lewis (1954).

4.3. Structural Change Term and Within Sector Labor Productivity Growth Rate

In addition to the labor productivity of each sector, we can explain sectoral productivity performance in terms of structural change and within sector labor productivity growth. McMillan and Rodrik (2011) proposed a shift-share mechanism to decompose aggregate labor productivity to structural change and within labor productivity. While structural change term ⁶ is a valid indicator of structural change that measures the change in labor productivity due to relocation of labor between sectors, within sector labor productivity growth is the gain in labor productivity due to technological advancement in each sector.

Based on our estimation of structural change, the countries have been gaining an average of 0.915% increase in labor productivity annually since 1991 due to the relocation of labor between sectors. The result coincides with the theory which affirms that for developing countries with a relatively large proportion of their population is employed in the low productive agricultural sector, structural change is likely to be positive and that is what has happened. While the gain in labor productivity for these countries ranges from – 8.6% to 5.7% between 1991 to 2017, the standard deviation is found to be 2.28 which is relatively low. Therefore, there exists a minimum level of cross-country differences when it comes to the average level of structural change they have achieved.

Table 2: Summary Statistics of Structural Change and Within Sector Labor Productivity Growth Rate

Variables	Mean	Standard deviation	Minimum	Maximum
Structural change term	0.915238	2.28373	-8.6021	5.747
Within sector productivity growth ⁷	0.933	3.814428	-9.01882	13.5384

Source: Author's calculation based on WDI

6 Structural change term measures the change in labor productivity due to relocation of labor between sectors. Based on the shift-share analysis, structural change term is calculated as follows:

Let overall labor productivity at time t and t-1 are given as Y_t and Y_{t-1} respectively and corresponding sectoral labor productivity are given as y_t^i and y_{t-1}^i with index i referring to different sectors. Given θ_t^i is the share of employment of each sector i at time t, the structural change term is calculated by using the following equation.

$$\sum_{i=n} (\theta_t^i - \theta_{t-1}^i) \overline{y_{i,t}}$$

7 Within sector labor productivity is calculated based on the following formula:

$$\sum_{i=n} (y_t^i - y_{t-1}^i) \overline{\theta_{i,t}}$$

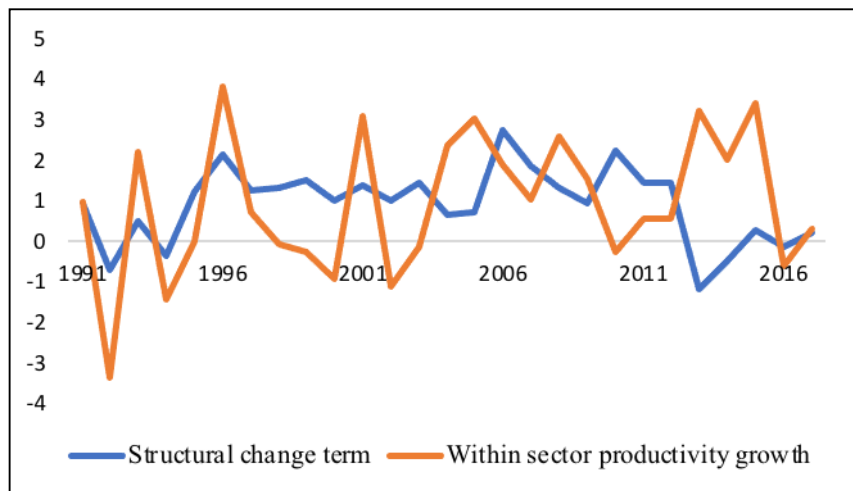
where y_t^i and y_{t-1}^i are sectoral labor productivity with index i referring to different sectors, θ_t^i is the share of employment of each sector i at time t and Y_{t-1} is the base year level of aggregate labor productivity in the economy.

Similarly, the average within-sector labor productivity growth rate due to technical change in each sector is 0.93% which ranges from - 9.02% to 13.54%. When it is compared with structural change term, countries have gained a higher labor productivity due to technological advancement than due to relocation of labor.

However, a t-test revealed that the gains in labor productivity from the two sources are systematically the same. These countries have been gaining labor productivity equally from both sources. We were unable to reject the null hypothesis of no difference in the mean values of structural change term and within labor productivity change.

However, based on Table 2 and Figure 4, within sector labor productivity growth tends to be more volatile than structural change term. The standard deviation of the within sector productivity change is 1.67 times higher than that of structural change term. This is because, according to Rodrik, McMillan and Sepulveda (2016), labor mobility is costly and a long-term decision while technological change happens unexpectedly and frequently. Therefore, within sector labor productivity growth rate changes more frequently for the changes in technological advancement than structural change term.

Figure 4: Structural Change Term and Within Productivity Change in a Sample of African Countries



Source: Author's calculation based on the data from WDI

Disaggregating the total average productivity change into structural change and within productivity change helps to show the relative strength of the change in labor productivity at different periods. For example, as it is shown in Table 3, from the years 1991 to 1995, while labor productivity has shown a 0.3211% growth rate due to structural change, the within labor productivity was declining by 0.3262% growth rate which minimizes the overall growth rate of

labor productivity to -0.0051% . Similarly, labor productivity change due to relocation contributes more to the total labor productivity change for almost all years considered in this study. But for 2016-2017, the contribution of within labor productivity change outweighs the structural change term. In general, for the last 25 years, structural change contributes more to labor productivity growth than within sector productivity.

Table 3: Disaggregated Components of The Total Average Productivity Growth Rate of Sample Countries for 1991-2017, by Taking 5-Year Average

Years	Structural Change	Within productivity	Total average labor productivity Change
1991-1995	0.32113843	-0.3262458	-0.0051073
1996-2000	0.55876193	0.24523567	0.8039976
2001-2005	1.29820433	0.5180952	1.81629953
2006-2010	1.30770737	1.21490137	2.52260873
2011-2015	1.55823353	1.09264007	2.6508736
2016-2017	0.13136867	1.885793	2.01716167

Source: Author's calculation based on the data from WDI

Country specific decomposition of aggregate labor productivity growth is indicated in Table 4.

Table 4: Decomposition of Aggregate Labor Productivities into Structural Change Component and Within Labor Productivity Component, from 1991—2017, by Country

Country	Structural Change term	Within labor productivity growth rate	Aggregate labor productivity growth
Burkina Faso	2.01094372	0.76628122	2.77722494
Ethiopia	0.11915479	2.5390648	2.65821959
Madagascar	0.8153982	-1.9043103	-1.0889121
Mozambique	1.44086392	1.78580441	3.22666833
Tanzania	1.09935723	0.31613287	1.41549011
Uganda	0.0057107	2.09677596	2.10248666

Source: Author's calculation based on the data from WDI

Mozambique and Burkina Faso achieved the highest aggregate labor productivity growth rate which is originated from different sources. Based on Table 4, while Mozambique generated most of its aggregate labor productivity growth from within sector labor productivity, Burkina Faso gets more than 72% of its growth rate of labor productivity from structural change. In the case of Burkina Faso, sectoral labor productivity has been changing dramatically for the last 26 years. Labor productivity in agriculture has been increasing continuously when it was declining for the manufacturing and service sectors. Based on our sectoral labor productivity estimation, in 1991, labor productivity in agriculture, manufacturing and service sectors was 303.024, 3582.6 and 5282.6 respectively. However, by 2017, labor productivity in agriculture, manufacturing and service sectors became 2113.4, 350.58 and 3007.94 respectively which confirms a radical change

in sectoral labor productivity due to a relocation of labor. From the above dynamics, we can understand that labor has been relocated towards the manufacturing and service sectors.

5. Methodology and Empirical Findings

The main objective of the study is to determine whether – and to what extent – structural change is influencing TFP in a sample of African countries. We used fixed effects with Driscoll-Kraay standard error panel data estimation technique, an important method to eliminate the incidences of heteroskedasticity, autocorrelation and cross-sectional dependency (Hoechle, 2007).

Theoretically, a change in TFP due to a change in employment structure occurs with one or more lags. This is because, for the productivity to shift due to structural change, there shall be a reallocation of labor from one sector to the other. Therefore, keeping this in mind, the following empirical estimation strategies are developed.

5.1. Model Estimation Technique

Mallick (2015) examined structural change and its effect on productivity growth for BRIC countries. He estimated total factor productivity (TFP) as a function of FDI, trade volume, fixed investment, industrial output, education sector expenditure, and the female labor force. Similarly, Mastromarco and Zaglo (2012) used technological investments and spillovers, human capital and regional banking inefficiency as determining factors to affect TFP growth while Cardarelli and Lusinyan (2015) modeled TFP growth rate as a function of schooling, log schooling, tertiary education attainment, business, and total R&D expenditures and time trend.

In this study, TFP is modeled in terms of within sector labor productivity change (served as a proxy for sector-specific technological advancement), structural change term, openness index, regulation quality of the country, foreign direct investment, dependency on raw material export, human capital index and finally labor productivity in the agriculture sector.

Table 5: Variables, Sources of Data and Expected Sign

Explanatory variable	Sources of data	Dependent variables			
		TFP	Sectoral labor productivity		
			Agriculture	Manufacturing	Service
Structural change term	Own computation based on WDI	+	+	±	-
Within productivity growth(t-1)	Own computation based on WDI	+	+	+	+

Structural change term (t-1)	Own computation based on WDI	+	+	±	-
Openness	WDI	±	+	+	±
Regulatory quality index	World governance index	+	+	+	+
Foreign direct investment	WDI	+	+	+	+
Raw material export (%ge)	WDI	+	+	0	-
Agricultural Labor productivity (natural log)	Own computation based on WDI	+	0	-	-
Human capital Index	Penn world table 9.0	+	+	+	+

Note: While the + sign hypothesizes positive relationship between variables, - predicts the opposite. ± shows the possibility of either positive or negative relationships depending on the circumstances but 0 shows no relationship.

Table 5 shows the explanatory variables, source of data and the sign of their expected effect on the dependent variables. Theoretically, technological change, which is represented by the within sector labor productivity change in the regression, is the main component of TFP. TFP in the neoclassical growth theory is treated as a technical component of the production function. Therefore, sectoral technical change constitutes technological advancement and knowledge transfer and by implication TFP. Empirically, different works of literature (For example, Plastina and Lence (2018); Jajri (2007); Mariyono (2018); Mastromarco and Zaglo (2012)) have concluded that technological advancement is the largest contributor for the change in TFP and TFP growth rate.

On the other hand, growth-supporting structural change is supposed to increase TFP growth rate. The relocation of labor towards a more productive sector increases the overall productivity growth of the country. This happens when the sector that labor is joining is already enriched with labor augmenting technology. Therefore, theoretically, structural change term increases aggregate TFP growth rate of a country, but it might have different signs for sectoral TFPS depending on the proportion of labor employed and the nature of technological advancement that resides in the sector.

Openness is included in the model to control the role of international trade on TFP and sectoral labor productivity. More open economies have a high level of technology transfer which by implication affects TFP of the economy (Abizadeh and Pandey, 2009). On the other hand, regulation quality helps the resource mobility towards the more productive sectors. Therefore, openness and regulatory quality indexes are expected to have a positive and significant effect on TFP growth rate of developing countries.

Similarly, human capital and productivity of labor in the agricultural sector are supposed to have a positive effect on TFP while dependency on raw material export might have a negative effect. The latter relationship is dependent on the development level of the country. Dependency on the

export of raw materials in international trade can help developing countries in boosting their TFP by compelling them to use modern technologies to keep up with the competition. However, for high-income countries with the dominant modern sector, dependency on raw materials export might have a decremental effect on the TFP of agriculture. As a result, dependency on raw material export which is measured as a percentage of total export in our analysis is expected to have a positive sign.

Hence, to empirically examine the above theoretical predictions, the panel data estimation technique is employed. However, due to the existence of heteroskedasticity, autocorrelation and cross-sectional dependency among the panel elements, we will not be able to use pooled ordinary least square (OLS), random effects and fixed effects estimation techniques but fixed-effects regression with Driscoll-Kraay standard error. Dynamic panel data estimation techniques are not useful in this context because they are more useful for models with “N greater than T” structure that are usually found in microeconomic studies.

According to Hoechle (2007), a fixed-effects model with Driscoll and Kraay standard errors estimation technique is implemented in two steps.

In the first step, all model variables $z_{it} \in \{y_{it}, x_{it}\}$ are within-transformed as follows:

$$\tilde{z}_{it} = z_{it} - \bar{z}_i + \bar{z} \quad (3)$$

where $\bar{z}_i = T_i^{-1} \sum_{t=t_{i1}}^{T_i} z_{it}$ and $\bar{z} = (\sum T_i)^{-1} \sum_i \sum_t z_{it}$

Considering the above estimator as the OLS estimator of $\tilde{y}_{it} = \tilde{x}_{it}'\theta + \tilde{\varepsilon}_{it}$,

Then the second step estimates the transformed regression model of

$$\tilde{y}_{it} = \tilde{x}_{it}'\theta + \tilde{\varepsilon}_{it} \quad (4)$$

Equation 4 is estimated by using pooled OLS estimation with Driscoll-Kraay standard errors. This estimation technique can also handle missing values and unbalanced panels (Hoechle, 2007).

5.2. Estimation Results and Discussion

Four different models are estimated to determine the effect of structural change on the growth rate of TFP and sectoral labor productivity of each major sector in these countries. The estimation results are presented in two separate tables. While table 6 presents the estimation result where aggregate TFP growth rate is regressed against structural change and other control variables, table 7 presents three regression results that estimate the effect of structural change on the productivity of labor in each sector.

5.2.1. The Effect of Structural Change on Aggregate TFP Growth Rate

Table 6: Fixed Effects Panel Data Estimation of Structural Change on the Growth Rate of TFP Based on Driscoll-Kraay Standard Errors

Explanatory Variables	Dependent Variable: TFP growth
Within productivity growth	0.125***(0.0227)
Structural change term	0.152***(0.0475)
Within productivity growth (with 1 lag)	0.0694***(0.0179)
Structural change term (with 1 lag)	0.245***(0.0601)
Openness	0.252(1.258)
Regulatory quality index	3.382***(0.904)
Foreign direct investment	0.120***(0.0350)
Raw material export (% to the total)	-0.0616(0.0531)
Agricultural labor productivity	0.352(1.143)
Human capital index	7.141***(1.491)
Constant	-7.305(7.450)
Number of observations	162
Number of countries	6
Prob > F	0.0000
within R-squared	0.5165

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

According to Table 6, the structural change term affects the growth rate of TFP positively and significantly at a 1% significance level. This supports the idea that relocation of labor towards more productive sectors affects the growth rate of TFP. Based on the coefficient estimates, if labor productivity gains due to the relocation of labor increases by 1%, TFP growth rate will increase by an average of 0.152%. At the same time, a one-year lag value of structural change term is also affecting TFP growth significantly. This implies that TFP growth responds to the changes in structural change term twice. In other words, a change in structural change at time t increases TFP growth at t and $t + 1$. Therefore, these countries shall work to advance the relocation of labor from the low productive sectors to the high productive sectors so that they can increase total factor productivity growth of their economy. However, it may not work for other countries and regions. For example, for the new EU member countries, inter-sectoral movements of labor do not play a large role in aggregate TFP growth and capital accumulation (Bah and Brada, 2009).

Furthermore, the growth rate of aggregate TFP is positively and significantly affected by the regulatory quality index, foreign direct investment, within sector labor productivity growth and human capital index. This result is supported by economic theory. On the other hand, openness index, percentage share of raw material export and agricultural labor productivity are found to be insignificant in affecting the growth rate of TFP in these countries.

5.2.2. The Effect of Structural Change on Sectoral Labor Productivities

In this section, structural change is regressed against the natural log of labor productivities of main sectors: agriculture, manufacturing and service sectors. And the estimation results are presented in Table 7.

Table 7: Fixed Effects Panel Data Estimation of Structural Change Term on Sectoral Labor Productivity Based on Driscoll-Kraay Standard Error

Explanatory Variables	Model I	Model II	Model III
	Labor productivity in agriculture	Labor productivity in manufacturing sector	Labor productivity in service sector
Within productivity growth	0.0126** (0.00576)	0.00399 (0.00523)	0.0128* (0.00664)
Structural change term	-0.00442 (0.00808)	0.0154 (0.0147)	0.00558 (0.0109)
Within productivity growth (with 1 lag)	0.0156*** (0.00455)	0.0154** (0.00639)	0.0163** (0.00707)
Structural change term (with 1 lag)	0.00569 (0.00601)	-0.000426 (0.0135)	-0.00632 (0.00912)
Openness	0.252* (0.141)	-0.448** (0.184)	-0.177 (0.140)
Regulatory quality index	0.116 (0.123)	0.290** (0.137)	0.332 (0.238)
Foreign direct investment	0.00932*** (0.00309)	0.00716 (0.00699)	0.0177*** (0.00607)
Raw material export (%ge to the total)	-0.0303*** (0.00551)	0.0166* (0.00814)	0.0165** (0.00686)
Agricultural labor productivity		-0.763*** (0.130)	-0.0126 (0.123)
Human capital index	0.0366 (0.182)	1.423*** (0.248)	1.252*** (0.182)
Constant	6.428*** (0.372)	9.866*** (1.089)	5.958*** (0.819)
Number of observations	162	162	162
Number of countries	6	6	6
Prob > F	0.0000	0.0000	0.0000
within R-squared	0.6046	0.6243	0.3599

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Thus, structural change but within sector productivity change is not helping to boost sectoral labor productivities. The result corresponds with Moussir and Chatri (2019) and with Mallick (2015) somehow. Moussir and Chatri (2019) found that the intra-sectoral (within) component would account for much of labor productivity growth rather than the structural change. Similarly, Mallick (2015) estimated the effect of structural change on labor productivity for BRIC countries

and found a significant relationship only in China and India. But for the rest, structural change was not significant in affecting sectoral labor productivity.

On the other hand, intra-sectoral (within) labor productivity component is contributing to the growth of labor productivities in agriculture and service sectors. However, it takes a year to increase labor productivity in the manufacturing sector.

In general, structural change is insignificant in determining sectoral labor productivities in selected African countries due to one or more of the following reasons:

- A large proportion of the population in these countries is employed in agriculture. At the same time, a considerable number of labors are entering to the sector. Therefore, the change in productivity of labor in the agriculture sector due to relocation of labor is insignificant.
- Relocation of labor is a long-term and costly decision and it follows a relatively slow process. Therefore, even if there is a high level of sectoral labor productivity gap between modern and traditional sectors, it takes time to fill the gap through a slow process of relocation for labor. As a result, the modern sector may not be matured for a while to result in a change in labor productivity as a consequence of labor mobility.
- The underdeveloped service sectors that resides in urban areas provides an opportunity as a new area of employment and business startups for the relocated labor which keeps its effect on labor productivity non-existent.

Hence, the above forces may hinder rapid change in sectoral labor productivity as a result of a structural change.

However, while within sector labor productivity growth affects labor productivity in the service sector positively. The increase in labor productivity due to technological advancement in each sector is found to increase labor productivity in the service sector twice in two consecutive periods. Technological advancement in agriculture and service sectors results in an increase in labor productivities in their respective sectors.

While openness index has a positive effect on labor productivity in the agriculture sector, it has decreasing effect on the manufacturing and service sectors. This makes sense for developing countries. These countries are known to have a comparative advantage in the export of agricultural products. On the other hand, since they are net importers of manufactured and service products, domestic manufacturers and service providers will not be able to keep up with the international competition. Therefore, the more open the economy becomes, the higher labor productivity in agriculture and the lower in the manufacturing and service sectors will be.

But the regulation quality index is found to affect labor productivity in the manufacturing sector positively and significantly at 5% significance level. The higher the regulation quality index, the better the resource allocation will be. Therefore, labor will be located in a way to increase its productivity. For example, Medreseh et al. (2018) agreed that the proper and logical use of

abilities and talents helps to improve labor productivities in the manufacturing sector. But foreign direct investment is significant in increasing labor productivity both in the agriculture and service sectors. However, it has no effect on labor productivity in the manufacturing sector. Most FDI in these countries is done in either agricultural or service sectors.

Human capital index, on the other hand, has an increasing effect on labor productivity in the manufacturing and service sectors. But it doesn't have any effect on labor productivity in agricultural sector. This result partially agrees with Huffman (2000) as he asserted that the effect of educational attainment in agriculture is rather dependent on conditions like the use of communication and information technology and the existence of options for off-farm work and migration. If these conditions exist, education in particular and human capital index in general, affects labor productivity in agriculture positively and significantly. But with the absence of communication and information technology, which is among the common characteristics of African countries, human capital may not have a significant effect on labor productivity in the agriculture sector.

6. Conclusion

This study shows empirically how the structural change in selected African countries affects aggregate TFP growth rate as well as labor productivity of major sectors. To this end, we used a dataset that covers from 1991 to 2017. Using a fixed-effects model with Driscoll-Kraay standard error estimation technique, the study concludes the following:

- On average, the labor in the service sector is 5 times and labor in the manufacturing sector is 3.4 times more productive than labor in the agricultural sector which indicates the prevalence of substantial gap in labor productivity between sectors.
- Following this gap in labor productivity, there is a relocation of labor mainly from agriculture to modern sectors which results in a positive structural change
- Labor productivity in the agriculture sectors is very low and sometimes declining, therefore, reallocation of labor to the manufacturing and service sectors will help to increase aggregate labor productivity in the short run
- The ratio of labor productivity in agriculture and non-agriculture sectors exhibits a U-shaped pattern which indicates the change of pattern in the gap of labor productivity between sectors.
- TFP has increased until 2012 and started to decline in corresponds with the GDP growth rate of most of the sample countries.
- The structural change affects the growth rate of TFP positively. However, it is insignificant in affecting sectoral labor productivity. The “unlimited” supply of labor in the traditional sector, unmet labor needs in the modern sector along with the slow and costly process of structural change may hinder sectoral labor productivity to react for the change in the structure of the economy.

Therefore, these countries can facilitate structural change to increase the growth rate of TFP. However, sector-specific labor productivity doesn't respond to the structural change but to technical advancement in each sector.

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